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A Study on the Wireless Sensor Network System to Monitor Yields of Agriculture Products

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Abstract. In this paper, we design and implement wireless sensor nodes and base station for a yields monitoring system for agriculture. Also, we develop an energy efficient communication protocol between sensor nodes and base station. A sensor node is fixed in a box for agriculture products, and monitors whether agricultural products are put in the box. The sensor node communicates with a base station to send the status of the box. The base station gathers the status of each box. We implement sensor nodes and base stations in an apple farm for experiments. The experimental results show that our system monitors the yields of agriculture products in real time.

Keywords: monitoring system, sensor node, agriculture products, traceability

1 Introduction

The development of sensor network technologies is closely related to the development of its applied fields. As discussed in [1], the sensor network technologies utilized in agriculture may produce various types of results depending on the application purpose of the technologies. The efficiencies of the various types of sensor network technologies have been verified. Precise agriculture enables tailor-made agriculture for crops by monitoring the growth environment data for agricultural products, as well as the distribution of agricultural products with understanding of the delivery path of the products through tracking technologies. Many applications include fields related to management after harvest and quality management of the agricultural products with understanding of the distribution paths and providing the optimal path.

This paper is about sensor network technologies which measure the production amount of agricultural products in producing areas in real time. The features in the agricultural sector shall be considered first to apply the sensor network technologies. A major factor in agricultural products is that it is difficult to increase or decrease the yield. Too much production reduces the price, and the price surges in the opposite

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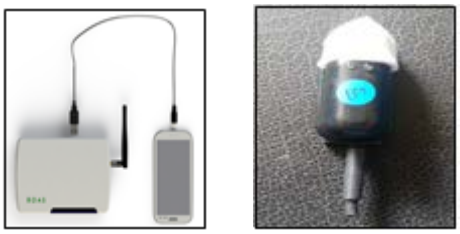
case. This requires forecasting the yield of the production. These problems may be minimized by forecasting the crop yield from the production areas.

There have been several studies [2-4] on forecasting the crop yield to level out the issues, because yield prediction is crucial in the field of agriculture. This study developed sensor nodes which may be installed in agricultural product boxes as an idea to utilize wireless sensor network technologies to predict crop yield to measure the production amount shipped from a site in real time. To this end, this study implemented the sensor tags attached to a container, base station, and monitoring system, and installed equipment at storage facilities and farms to check the applicability and accuracy of the system. Also, we compared and verified the storage amount and the yield from farms in real time to upgrade the precision of the yield measurement.

2 System design

The components of the sensor network system are the sensor tags, base stations, and monitoring system. Fig. 1 shows the base station and the sensor tag.



(a) Base station (b) Sensor node

Fig. 1. Implemented base station and sensor node

The sensor tag is powered by a 3.6-V and 1.2-Ah primary battery with a life of at least 2 years. The SRD RF is designed using a 424-MHz narrow-band frequency. The block diagram shows a module which applies a CC1020 RF transceiver IC, which is the same as with the base station. Fig. 2 shows the design structure of the sensor tag and base station.

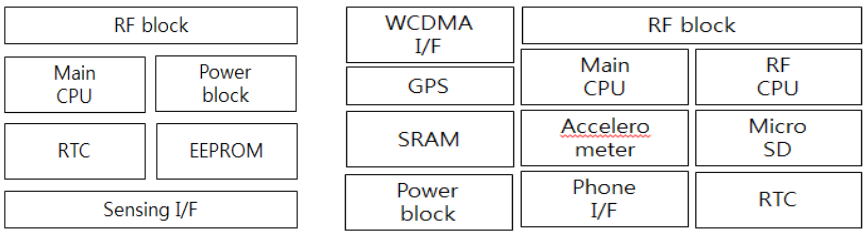


Fig. 2. Architecture of sensor tags & base stations.

The base station designed and implemented in this paper is a system that may be used in local and foreign environments without additional configuration process. The WCDMA modem used in the base station is a WM-211 external modem and provides service of high-speed wireless data connection to various industrial equipments. The system consists of an antenna connector, power connector, and 30-pin board connector, and it may be used to connect to an existing host system with a cable. Also, the system may be installed on a PCB of a host system through the 30-pin board connector. The system has a ZM5202 modem manufactured by ZTE that provides internal TCP/IP and SMS functions. Function in connection with a smartphone has been implemented. The connection with the smartphone is performed by RS-232 communication to a Micro USB cable. Fig. 2 shows these concepts.

3 Conclusion

This paper designed and implemented a base station, a component of wireless sensor network system that plays a role of receiving and storing data transmitted from sensor tags and regularly transmitting it to a he remote server. The system was implemented based on WCDMA to be used in local and foreign environments without additional configuration and to provide various services based on the location information by installing GPS. Also, the system implements functions of the base station and smartphones to secure convenience for the management of the collected data. In particular, the system introduces an algorithm with low power for the system, which is a major feature of the sensor network system to secure system continuity. It was confirmed that the measurement and management system for agricultural product distribution with the base stations proposed by this study shows efficient performance.

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